effects. A frequency-to-voltage converter can reconvert the pulse train to an analog voltage. The result is a cheap, compact circuit in which the duty cycle of the pulse train at F_{OUT} is directly proportional to the measured quantity. Alternatively, you can feed the pulse train into a counter to generate a digital signal. In this case, the gate signal of the counter determines the resolution of the system. For example, the gate interval must be at least equal to $1024/(0.9 \times CLK_{IN})$ for a resolution of 10 bits.

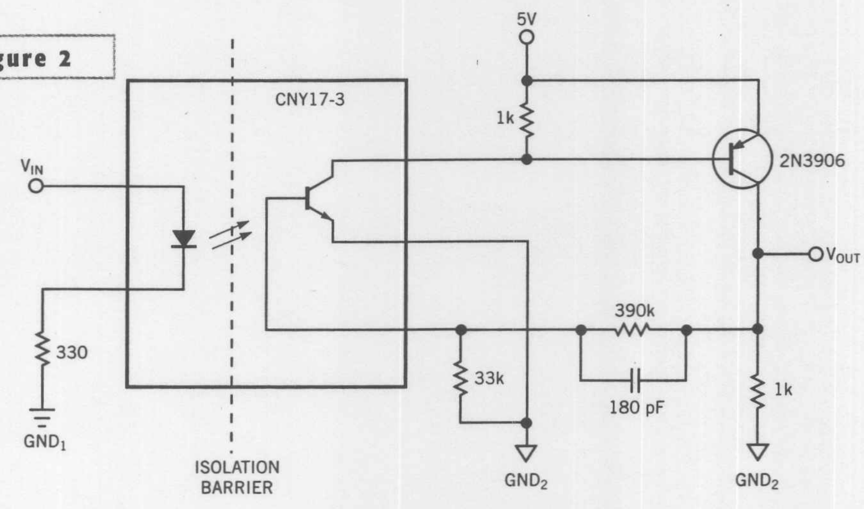
A disadvantage of the circuit in **Figure 1** is that the speed of the optocoupler determines the maximum frequency of F_{OUT}. Low-cost optocouplers have low switching speeds, and their high-speed counterparts are often expensive. Adding positive feedback to the light-sensitive base of the phototransistor greatly increases its switching speed (**Figure 2**). By adding one transistor, four resistors, and a capacitor, this circuit increases the maximum data-rate capability of the optocoupler by a factor of 10.

Another approach is to use a differential line driver (**Figure 3**). Adding the differential line driver increases the maximum frequency through the PS2502-2 optocoupler from 5 to 32 kHz. This approach ideally suits low-power applications for which the clock rate of the VFC is typically 32 kHz. At V_{DD}=3V, the power dissipation of the VFC is typically 2.7 mW, and you can further reduce this number by gating off the CLK_{IN} input when the circuit is not monitoring V_{IN}. This action shuts down the VFC, and its power dissipation typically reduces to 0.09 mW. For a range of 0V to V_{DD} on V_{IN}, the corresponding output range of F_{OUT} is 3.2 to 28.8 kHz.

DIGITAL ISOLATION

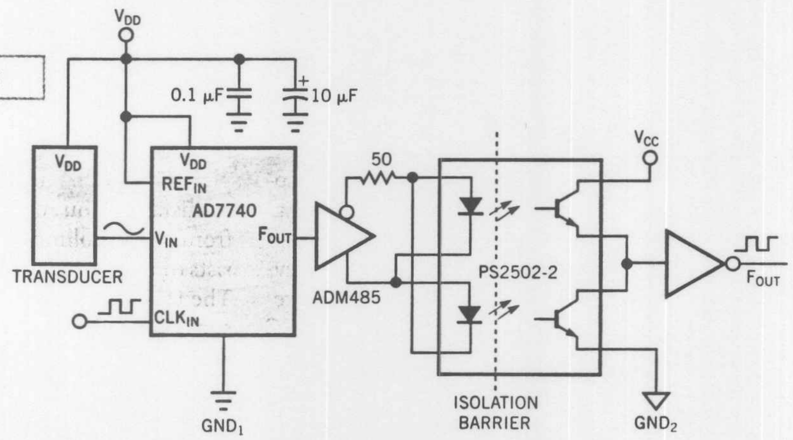
For applications that require high-speed data transmission, you can use digital-isolation techniques. The digital isolator in **Figure 4** combines high-speed CMOS and air-core-transformer technology, supports data rates from dc to 100 Mbps, and operates at low power. The device has a quiescent current of 0.6 mA and a dynamic current of less than 230 µA/Mbps. The circuit clocks the VFC at its maximum frequency of 1

Figure 2



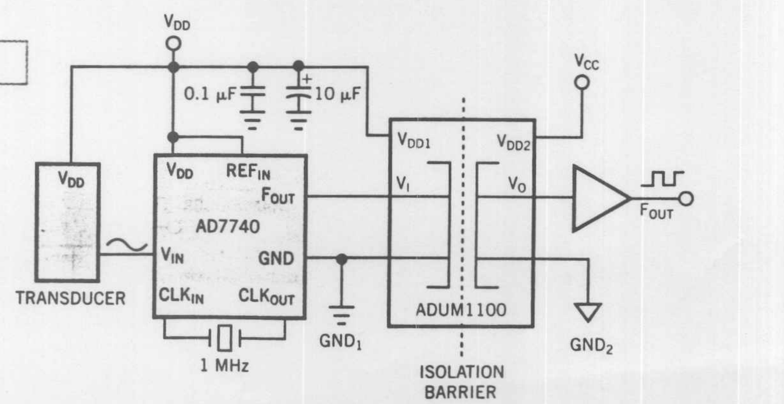
Adding positive feedback to the light-sensitive base of the phototransistor greatly increases its switching speed—in this case, to a maximum speed of 500 kHz.

Figure 3



For low-power applications, adding a differential line driver increases the maximum frequency through the optocoupler from 5 to 32 kHz.

Figure 4



A digital isolator provides for high-speed data transmission—in this case, from dc to 100 Mbps.